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SOME PROPERTIES OF PLANT SUBSTANCES IN RELATION TO CLIMATE OF HABITAT—VOLATILE OILS, SAPONINS, CYANOGENETIC GLUCOSIDES, AND CARBOHYDRATES

JAMES B. MCNAIR

Reprinted from AMERICAN JOURNAL OF BOTANY, Vol. XIX, No. 2, February, 1932.

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THE EVOLUTIONARY STATUS OF PLANT FAMILIES IN RELATION TO SOME CHEMICAL PROPERTIES

JAMES B. MCNAIR

Reprinted from the AMERICAN JOURNAL OF BOTANY, Vol. 21, No. 8, October, 1934

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Angiosperm phylogeny on a chemical basis

JAMES B. intley McNAIR

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The taxonomic and climatic distribution of alkaloids

JAMES B. McNAIR

Separately printed, without change of paging, from BULLETIN OF THE TORREY BOTANICAL CLUB 62: 219-226. April, 1935.

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ENERGY AND EVOLUTION

James B. McNair

The object of this paper is to develop the theory that species formation occurs during periods of increased activity, that plants which do the hardest (most difficult) work have evolved to the highest positions; that in this regard quality of products is more important than quantity; and that as morphological structures evolve from simple to complex, so plant chemical compounds evolve from simple to complex.

Species Definition from a Chemical Standpoint. - It is assumed that each species is in a state of mobile equilibrium between reversible reactions which fluctuate and are mutable under the action of modifying agents (Marcello, 1930). Individuality has, therefore, a complex chemical basis. The existence and permanency of a species is controlled and depends upon the existence of constant external and internal conditions and shows a fixed ability to synthesize characteristic compounds which constitute its physiologico-chemical characteristics (in part S. L. Ivanov, 1926). Thus, an increase in habitat temperature will stimulate the formation of more saturated fatty acids in glycerides and vice versa. Also, at moderately elevated temperatures starch is formed in evergreen leaves which is converted into oil when the temperature is gradually lowered and vice versa (Tuttle, 1919). As another instance of change of conditions affecting plant physiologico-chemical characteristics we know that an increase in water in the soil and in the plant promotes oil formation and vice versa (Sinnott 1917, Ivanov, Lavrova and Japochko 1931, Geddes 1934, Halden 1934). The concentration of electrolytes in plants is a factor controlling the amount of alkaloids and cyanogenetic compounds formed (McNair, 1941). As instances of the effect of internal conditions on plant chemical products we have the influence of changes in genetic constitution. Genetic strain affects HCN production in white clover (Williams, 1939) and sorghum (Nowosad and MacVicar, 1940). Genetic strain affects alkaloid production in tobacco (Rasmussen, 1915), opium (Annett and coworkers, 1920-1925), and aconite (Bonisteel, 1940, 1941). And genetic strain also affects the amount and distribution of oil in corn kernels (Pearl and Bartlett 1911, Lindstrom and Gerhardt 1926).

Species Developed During Greater Activity. - It is the consensus of opinion that although species may originate in a number of different ways they all originate during periods

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Thomas Horsfield

American Naturalist and Explorer

JAMES B. McNAIR

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42: 1-9. January-February, 1942

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Reprinted from MADROÑO, April, 1942, Vol. VI, No. 6, pages 181–190.

SOME CHEMICAL PROPERTIES OF EUCALYPTUS IN RELATION TO THEIR EVOLUTIONARY STATUS

JAMES B. MCNAIR

This paper presents comparisons of morphological and chemical characteristics of members of the genus *Eucalyptus* and shows that primitive species are primitive both morphologically and chemically and more recent species are advanced both morphologically and chemically. Chemical advance involves oxidation. But chemical and morphological advances do not necessarily progress hand-in-hand.

Baker and Smith (1, 2) after thirty years work classified the genus chemically and phylogenetically. Their phylogenetic ar-

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Vol. 11, No. 1, pages 1–59. January, 1945.

PLANT FATS IN RELATION TO ENVIRONMENT AND EVOLUTION

JAMES B. McNAIR

INTRODUCTION

In the search for proper identification of plant groups and their true sequence in evolution, the chemical and physical properties of their fats may be useful. The following paper constitutes a review of the literature directly pertaining to this thesis. In favor of the use of fats in this connection is their wide distribution throughout the plant kingdom. One of the properties of fats which are useful in such identification is their ability to absorb iodine. The iodine value or iodine number of a fat or fatty acid is the quantity of iodine (in mg.) absorbed by one gram of fat or oil under specified conditions.

However, some properties of fats, including their iodine values, are affected by environment. The literature shows that the iodine absorption values may change in relation to the amounts of fatty acids present, although the kinds of fatty acids may not be changed by environment. Under similar environments fats may be separated according to their sequence in evolutionary position. In addition to the usefulness of the iodine value as an indicator of a plant group, there is the nature of the fatty acids themselves. For instance, some fatty acids are found only in certain plant families, *e.g.*, myristic acid in the Myristicaceae, erucic acid in the Cruciferae (38). Other properties which have been found useful in the identification of plant groups are increase in the number of carbon atoms in fatty acids and increase in the number of acids in seed fats with advance in evolutionary position (88).

The literature also shows that iodine values of fats give numerical values for plant groups, and by them more definite comparative values for evolutionary appreciation are determined than are obtained by other classification methods, *e.g.*, serum diagnosis. For instance, the iodine numbers of their fats are for palms (Principes

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Some Comparisons of Chemical Ontogeny with Chemical Phylogeny in Vascular Plants

JAMES B. MCNAIR
(818 South Ardmore Ave., Los Angeles, Calif.)

There are resemblances between certain characters in the embryos of higher animals and corresponding stages in the embryos of lower animals. This is most plausibly explained by the assumption that they have descended from the same ancestors and that their common structures are embryonic survivals (Morgan, 1925). Perhaps then in some cases chemical ontogeny is to a certain extent an epitome of chemical phylogeny and vice versa. If this holds even partially true in plants, then we have a pattern which may aid in the phylogenetic classification of plants on the basis of their chemical products; a method to aid in the discovery of "missing links" in the formation of certain compounds along the phylogenetic chain; as well as a pattern for the study of chemical ontogeny through the study of chemical phylogeny.

THEORY OF RECAPITULATION IN ZOOLOGY

The theory of recapitulation was first considered in relation to animals. In some such sense as stated in the preceding paragraph it was early suggested in the writings of Meckel (1821), von Baer (1828) and Louis Agassiz; but it was first clearly formulated by F. Müller in 1863, and received its most sweeping applications in the works of E. Haeckel (1866). [For a good summary of instances in the animal kingdom see Jordan and Kindred (1930)].

Although the theory of recapitulation was formulated in general terms which could include both the animal and plant kingdoms, it owed its origin to the facts of animal life. For a long time it depended almost entirely for support on zoological evidence. However, it might be expected that if this fundamental biological principle holds true in the case of animals it should likewise apply to the plant kingdom.

The Key to PLANTS and PLACES of Interest

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